DEVELOPMENT OF SOLAR FLUORESCENT LAMP

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ABSTRACT

Solar cells are common examples in this category of electricity generation. They are also known as photovoltaic cells. A combination of individual PV cells forms the Photovoltaic module. A collection of photovoltaic modules, which are tied together with a wire and are so designed to install it in a field readily, is known as photovoltaic panels or simply solar panels. The installation includes the photovoltaic modules, an inverter, a battery all linked to each other with a wire.

Since this technology is still new in Malaysia especially in UMP. The using of solar as electric source is limited. So, in this case, I need to develop a system that uses solar panel as a basic supply for the Fluorescent Lamp. This project is mainly concerned in design a charger that uses solar as source to charge the battery 12 V. This project also designs the inverter from 12VDC to 240VAC. The inverter could be supply power to the load that we use in this project. The load is a Fluorescent Lamp. This project will be divided into two main parts which are hardware design and software development. The hardware includes the charger and the inverter. The charger will take the energy from the solar source and store it in battery. After that the battery will give supply to the inverter circuit to convert the direct current into alternating current. The most important thing in this project is to convert direct current DC into alternating current AC. By using suitable controller, it will change from square wave into sine wave. The controller can produce the waveform that we need. Lastly when we get the suitable power, voltage and current, we connect it to the Fluorescent Lamp as a load in this project.

ABSTRAK

Sel suria adalah salah satu kategori dalam penghasilan elektrik. Ia juga dikenali sebagai sel fotovoltan. Kombinasi satu sel PV akan menghasilkan module fotovoltan. Pengumpulan modul, merangkumi bersama satu rekabentuk yang hendak dipasang dikenali sebagai panel fotovoltan atau dengan erti kata lain panel suria. Pemasangan akan dilengkapi dengan panel suria, satu penyongsang, satu bateri and akan disambung dengan satu wayar.

Walaubagaimanapun, teknologi ini masih baru di Malaysia terutamanya di UMP. Penggunaan suria elektrik agak terhad. Jadi dalam hal ini, saya perlu mencipta satu sistem yang menggunakan panel suria sebagai pembekal utama untuk lampu Fluorescent. Projek ini akan tertumpu pada mencipta pengecas dari sumber suria untuk mengecas bateri 12 V. Projek ini juga mencipta penyongsang dari 12 NDC kepada 240 VAC. Penyongsang ini akan membekalkan kuasa kepada beban yang digunakan. Bebennya adalah lampu Fluorescent. Projek ini akan terbahagi kepada dua bahagian iaitu “hardware design” dan jalan kira untuk penggunaan kuasa. “Hardware” akan merangkumi pengecas dan juga penyongsang. Pengecas akan mengambil kuasa daripada suria dan menyimpannya kedalam bateri. Selepas itu bateri akan membekalkan kuasa untuk litar penyongsang supaya menukar arus terus kepada arus ulang alik. Apa yang paling penting dalam projek ini adalah untuk menukar arus terus DC kepada arus ulang alik AC. Dengan menggunakan pengawal litar yang sesuai, ia akan menukar “square wave” kepada “sine wave”. Akhir sekali, bila dapat nilai kuasa, voltan dan arus yang sesuai, sambungkan ia kepada lampu Fluorescent sebagai beban dalam projek ini.

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CHAPTER 1

INTRODUCTION

1.1 Overview

Solar panel described two types of devices that collect energy from the sun. It is solar photovoltaic modules and solar thermal collector. Solar photovoltaic modules are use solar cells to convert light from sun into electricity. Solar cells are common examples in this category of electricity generation. An electric power can be converting from one form to another by using electronic devices. The function of the electronic circuit by using semiconductor devices is to switching and modifying or controlling a voltage. It will convert electrical energy from one form to another form.

1.2 Background

Normally power electronic systems consist of two parts. It is power processor and power controller. Power process that handle power transfer from input to output and power controller that tell how the process need to do to get the output compared to input. It is shown in Figure 1.1.

In order to save energy from common use (TNB), we use another source to get the electricity. For example, use energy from solar. By using this energy, we just get the direct current DC. Is not suitable to our equipment that using alternating current AC. That means we need to converts DC to AC power by switching the DC input voltage (or current) in a pre-determined sequence so as to generate AC voltage (or current) output. By convert the input direct current DC to alternating current AC, it is suitable to our equipments. Figure 1.2 shown the inverter that converting DC input to AC output.

Application of power electronic range from low-power conversion equipment, for examples AC devices. Convertion of DC input from the battery to get AC output is shown in Figure 1.2. This DC-AC converter is also specifically classfied as a inverter. In order to get the power in AC, the power need to follow the specification of the equipment that we use. The voltage must be 240V at no load and not less than 220V at load. The frequency must be 50-60Hz. Lastly we need to consider the output power for the load. Therefore, this project is assigned as to design and build a suitable inverter for the load that we used. The load is Fluorescent Lamp. The power that load needed is about 5-20W. in order to get the pure sine wave, we need to add the filter circuit after we get the full wave of square wave. After passing the filter circuit, the output will change in sine wave. The block diagram of the filter is shown in Figure 1.3.

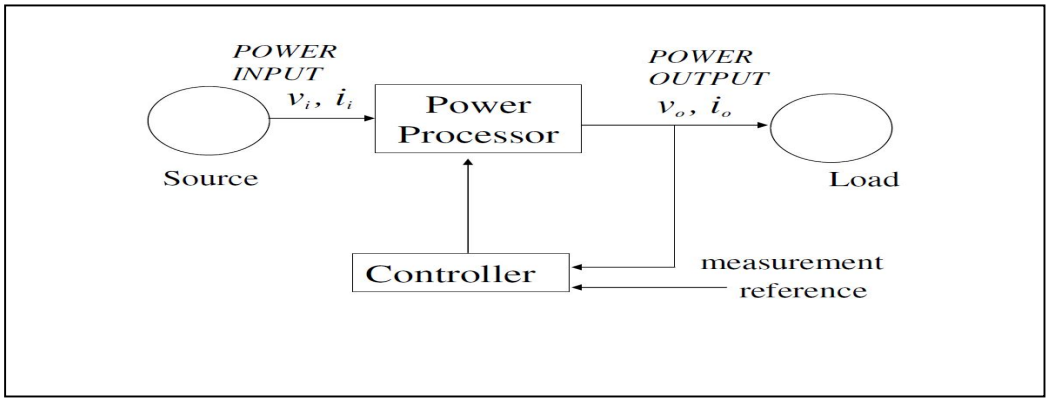

Figure 1.1: Basic Controller

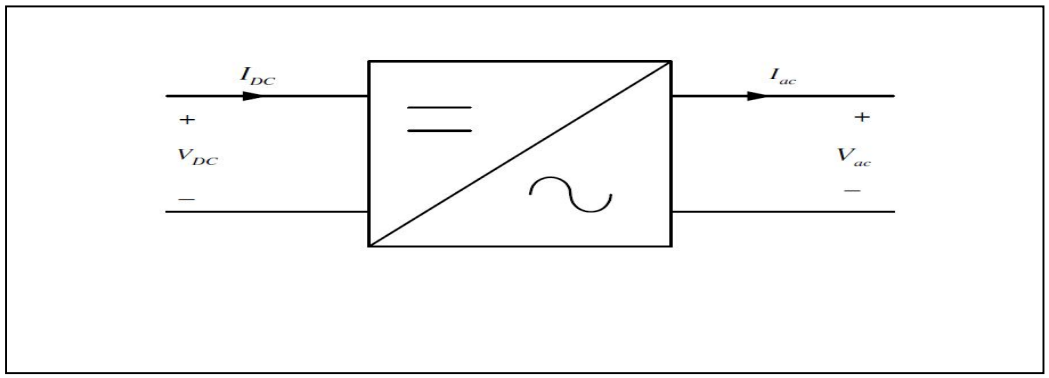

Figure 1.2 : Basic DC/AC

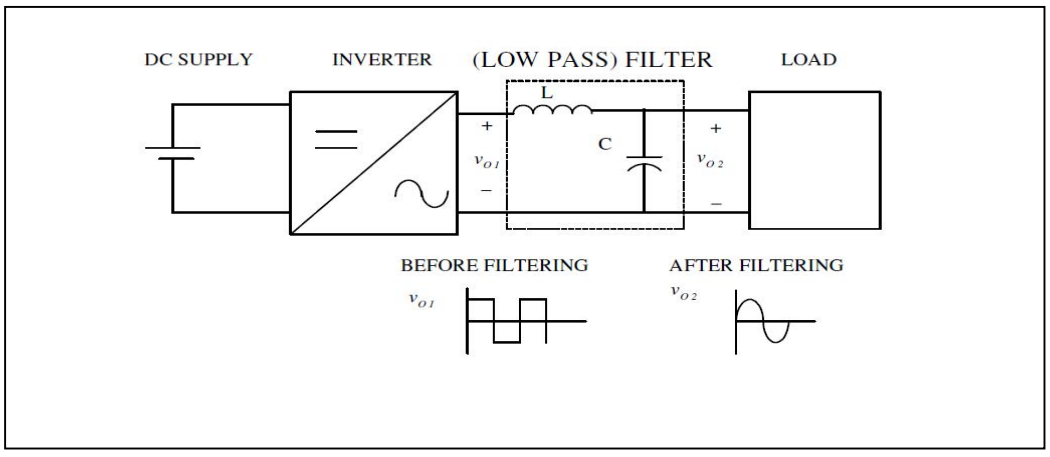

Figure 1.3: Filtering Diagram

1.3 Objectives

The main point of this project is to store the energy from the sun into the battery and to convert the DC voltage to AC voltage by using power electronic devices. In order to achieve the single phase AC voltage, it is required to design and create the suitable inverter for the load by using the source from the sun energy. Besides that, it is the objective of this project also to design and build the solar charger that can taking energy from the sun and store it into the battery 12V. To achieve all the objectives of this project, a lot of work must be consider before the project done. There are as stated below:

i. To develop a system that uses solar panel as a basic supply

ii. To design a suitable inverter to integrate with low power load

iii. To apply all the theory has been studied practically

1.4 Scopes

In this project, it will be focus on two parts; it is the hardware development and calculation of power consumption. The main scope of this project is to generate electricity from the sun energy (solar panel) and then store it to battery (12Vdc) by control with charger circuit.

For this project, the power consumption will be calculated manually. The battery used only 12V in constant voltage. After that the inverter produced only suitable for the load. The load in this project is Florescent Lamp and the inverter must be turn on the lamp after the control circuit is on.

In addition to this project, the external switches to control and protect the system from damage or short circuit. There are as stated below:

i. Generate electricity from the sun energy (solar panel) and then store it to battery (12VDC) by control with charger

ii. Only used 12V battery in constant voltage to supply to the inverter

iii. The inverter that will be used is 12DC-240AC/5-20W

iv. Get stabilized voltage for used at lower voltage devices

v. Additional circuit for control the system work properly.

1.5 Problem Statement

Today, the system that using the solar panel as a source for the fluorescent lamp is very hard to found, especially at the bus stop. In easy word is no installation of solar fluorescent lamp at bus stop in Malaysia. Today, technology is very important and very useful to us. So we need to find way to improve ourselves. For example, generate the electricity using energy from the sun light. That we call is the solar photovoltaic modules. Because of that, we not hope electricity from TNB only but we can make it ourselves.

That's why this system is designed. The problem here is we cannot produces constant supply for the load, so the charger needs to be design to store the energy to the battery. The output will stable when supply from battery is constant. Normally, the inverter is very hard to design because the input in DC and the output is AC, it is easy to burn. So the component must be suitable for higher temperature and higher efficiency. Nowadays, a lot of product used for DC load only, but this system is designed for load in AC

1.6 Thesis Organization

There are all five chapters being structure in this thesis and every chapter will elaborate in details about this project. Chapter 2 is about the literature review. The data and the theory will be taking from this part before move to the next chapter. Chapter 3 is all about the methodology. This chapter will be discussing about the flow or the method that applied into this project. All detail explanation about the project in this chapter. Chapter 4 is displaying the result and discussing about the project after all the circuit finish. Chapter 5 in overall will discuss about the conclusion and summary of the project. This chapter also states the problem and recommendation for the project.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In order to perform this project, literature review has been made from various sources like journals, books, articles and others. All of this will be references for this project and also make idea to produce suitable circuit or inverter for the charger and also the inverter. A review of the article was performed to identify studies that relevant to the topic. A combination of the following keywords was used to identify relevant material. The Solar Fluorescent Lamp concept is integrated the solar charger, battery, inverter and the sensor to switch ON the fluorescent lamp.

2.2 Solar Energy

A solar energy and electric lighting system wherein when the solar energy is available as in the day-time, it is utilized for lighting through conventional electric lamps, but when no solar energy is available the lamp are turned on [2]. Using the light sensor to detect weather no solar energy or not. The solar power source is suitable for powering outdoor advertising signs. Generally, the solar power source has application in any environment where the constant power source was desired [3]. It is suitable to apply to bus stop.

2.3 Solar Panel

Solar panel which is also known as photovoltaic is a device that receives the energy from the sun and then converts it to electrical energy. Solar panel has several types according to their size and output. It will produce DC voltage [4]. Its output which is 17Vdc 5A must be store to a battery. The present invention relates to means for concentration solar energy on solar cells, optimizing the utilization of solar energy [5]. Outdoor solar energy lamp with luminescence efficiency relates to lamp, and more particularly to an outdoor solar energy lamp that uses environmental solar energy as power source and has luminescence function to prolong lamp lighting [6]. By using the environmental source we get to generate the electricity and give the supply to the fluorescent lamp.

2.3.1 Solar Panel Specification

Model	Sunmodule SW80 mono/RSE
Rated Max. Power, Pmax(W)	80(±5%)
Open Circuit Voltage, Voc(V)	21.9
Rated Voltage, Vrated(V)	17.5
Short Circuit Current, Isc(A)	5.00
Rated Current, Irated(A)	4.58
Maximum System Voltage, (V)	715AC

Table 2.1: Solar Panel Specification

2.4 Battery

Nowadays maintenance-free lead-acid batteries are common in vehicles, inverters and UPS systems. If the battery is left in a poor state of charge, its useful life is shortened. It also reduces the capacity and recharge ability of the battery [13]. We use the lead-acid battery in this system or project because it is suitable to use for the inverter system.

2.4.1 Battery Specification

Figure 2.1: Battery

A lead-acid battery is a electrical storage device that uses a reversible chemical reaction to store energy. It uses a combination of lead plates or grids and an electrolyte consisting of a diluted sulphuric acid to convert electrical energy into potential chemical energy and back again. The electrolyte of lead-acid batteries is hazardous to your health and may produce burns and other permanent damage if you come into contact with it.

Voltage is an electrical measure which describes the potential to do work. The higher voltage will risk to you and your health. Systems that use voltages below 50V are considered low-voltage and are not governed by an as strict (some might say arcane) set of rules as high-voltage systems.

Current is a measure of how many electrons are flowing through a conductor. Current is usually measured in amperes (A). Current flow over time is defined as ampere-hours (a.k.a. amp-hours or Ah), a product of the average current and the amount of time it flowed. Lastly, Power is the product of voltage and current and is measured in Watts. Power over time is usually defined in Watt-hours (Wh), the product of the average number of watts and time. Your energy utility usually bills you per kiloWatt-hour (kWh), which is 1,000 watt-hours[17].

2.4.2 Acid Lead Specification

Model	Lead Acid 12V 7Ah
Battery Technology	Lead Acid
Energy Storage	7 Ah
Output Voltage	12 V
External Depth/Length/Width	65mm/97.5mm/151mm
Weight	2,65 kg

Table 2.2: Acid Lead Specification

2.5 Charger

The function of the charger circuit is to regulate the power flowing from a photovoltaic panel into the rechargeable battery. The energy from the sun will be taking and store it into the battery 12V. The charger will be charge the battery in certain time in order to make the battery full back. After the battery full, battery can be use for the inverter circuit. The goal of the circuit design was to make a charge controller with analog simplicity, high efficiency and reliability. A medium power solar system can be built with 12V solar panel up to 10 Amp [16].

2.5.1 TLC2272

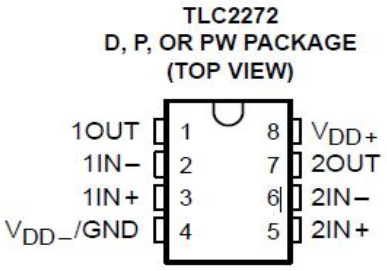

Figure 2.2: TLC2272

A TLC2272 is an operational amplifier IC and it can make a comparator either the voltage can flow trough it or not. Depend on this type the function in the charger circuit is to on and activated the transistor to allow the charge into the battery. This IC also makes the comparator based on the trigger oscillator to make the solar turn on and off.

2.5.2 IRF9Z34N

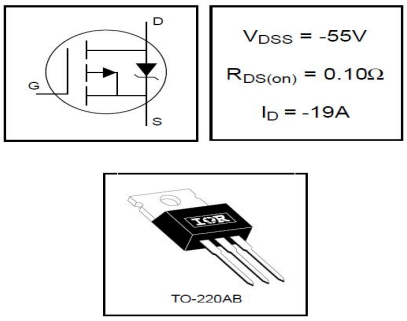

Figure 2.3: IRF9Z34N

A IRF9Z34N is a power mosfet or rectifier. When the transistor on, this mosfet will pass trough the voltage to the battery in high voltage. In other word this device can step up the voltage or current.